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(54) Title: **RADIANT ENERGY SOURCE SYSTEMS, DEVICES AND METHODS**

(57) Abstract: This document discusses, among other things, systems, devices, and methods that increase radiant energy output, such as by using the waste airflow of combusted gas and/or ambient airflow resulting from convection, or by reducing or avoiding cooling effects of such airflows. In one example, the collected energy can be used to drive other secondary radiant sources or to preheat combustion air or ambient air. In another example, segmented secondary radiant sources are thermally isolated from each other to operate as a cross flow exchanger that exchanges thermal energy from a heated gas to a heated surface that provides radiant energy output. In a further example, a re-radiant membrane can separate the radiant source from the environment and/or reconfigure the effective shape of the primary radiant energy source.

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A. CLASSIFICATION OF SUBJECT MATTER
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B. FIELDS SEARCHED

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Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

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EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 046 944 A (SMITH THOMAS M) 10 September 1991 (1991-09-10) columns 6-8; figures 3,17,20	1,2,4-7, 14,15, 17-20, 22-24, 40,46-48
X	US 3 307 529 A (MARC RESEK ET AL) 7 March 1967 (1967-03-07) columns 5-6,17; figures 1-4,9,10	1,2,4,5, 7,8, 10-12, 16-21
X	CH 359 861 A (SCHWANK CHRISTINA ERIKA ; SCHWANK BERND HEINRICH (DE)) 31 January 1962 (1962-01-31) page 2, lines 14-74 ----- -/--	1,2,5,7, 8,16,17, 19,20

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International Application No
PCT/US2004/010111

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	GB 842 596 A (PARKINSON COWAN APPLIANCES LTD) 27 July 1960 (1960-07-27) page 2, lines 50-102	1,2,4,5, 7,8,10, 17-19,21
X	US 4 722 681 A (SMITH THOMAS M) 2 February 1988 (1988-02-02) the whole document	1,2
X	US 3 709 140 A (RICKHOFF L) 9 January 1973 (1973-01-09) the whole document	1,2
X	US 6 098 614 A (FLEMING JOHN STUART) 8 August 2000 (2000-08-08) the whole document	1,2
X	FR 1 447 876 A (ROBERTS APPLIANCE CORP GORDON) 29 July 1966 (1966-07-29) the whole document	1
X	EP 1 077 348 A (BAUMANN HERBERT) 21 February 2001 (2001-02-21) paragraphs '0015! - '0021!; figure 1	24-28
X	EP 0 316 130 A (AMBI RAD LTD) 17 May 1989 (1989-05-17) column 2; figure 2	24
X	DE 29 40 801 A (SANDER WALTER) 23 April 1981 (1981-04-23) the whole document	36-38, 40,46-48
X	EP 0 514 930 A (SCHWANK GMBH) 25 November 1992 (1992-11-25) column 4; figure 1	24,36-39
X	CH 329 290 A (ROEMER RAOUL) 30 April 1958 (1958-04-30) pages 1-2; figures 1-4	24-27, 30,36,40
X	US 5 594 999 A (BEST WILLIE H) 21 January 1997 (1997-01-21) the whole document	24,36,40
X	FR 1 509 577 A (COWAN E J) 12 January 1968 (1968-01-12) the whole document	24,36
X	EP 0 162 445 A (GOGAS GOCH GMBH & CO) 27 November 1985 (1985-11-27) the whole document	31,35
	-/--	

INTERNATIONAL SEARCH REPORT

International Application No
PCT/US2004/010111

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT		
Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	GB 2 091 869 A (SHENG HSIUNG WENG) 4 August 1982 (1982-08-04) the whole document	31, 35
X	FR 1 283 540 A (OATLEY TECHNICAL DEVELOPMENTS) 2 February 1962 (1962-02-02) the whole document	40-48
X	FR 1 206 247 A (PRODUCTS AND LICENSING CORP) 8 February 1960 (1960-02-08) the whole document	40-48

INTERNATIONAL SEARCH REPORT

information on patent family members

International Application No

PCT/US2004/010111

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 5046944	A	10-09-1991	US 4272238 A 09-06-1981
			US 4654000 A 31-03-1987
			US 5090898 A 25-02-1992
			US 5145056 A 08-09-1992
			CA 1168568 A1 05-06-1984
			DE 3042580 A1 27-05-1981
			GB 2064096 A ,B 10-06-1981
			GB 2133526 A ,B 25-07-1984
			JP 56082312 A 06-07-1981
			US 4830651 A 16-05-1989
			US 4378207 A 29-03-1983
			US 4447205 A 08-05-1984
			US 4416618 A 22-11-1983
			US 4443185 A 17-04-1984
			US 4500283 A 19-02-1985
			US 5024596 A 18-06-1991
			US 4722681 A 02-02-1988
			US 5306140 A 26-04-1994
			JP 1759135 C 20-05-1993
			JP 4049004 B 10-08-1992
			JP 60213718 A 26-10-1985
			US 4604054 A 05-08-1986
US 3307529	A	07-03-1967	BE 670927 A 14-04-1966
			GB 1117712 A 19-06-1968
			NL 6513693 A 25-04-1966
CH 359861	A	31-01-1962	NONE
GB 842596	A	27-07-1960	NONE
US 4722681	A	02-02-1988	US 4290746 A 22-09-1981
			US 4272238 A 09-06-1981
			US 4416618 A 22-11-1983
			US 4654000 A 31-03-1987
			US 4035132 A 12-07-1977
			US 4830651 A 16-05-1989
			US 5090898 A 25-02-1992
			US 5145056 A 08-09-1992
			US 5024596 A 18-06-1991
			US 5306140 A 26-04-1994
			US 4373904 A 15-02-1983
			US 4447205 A 08-05-1984
			US 4443185 A 17-04-1984
			CA 1168568 A1 05-06-1984
			DE 3042580 A1 27-05-1981
			GB 2064096 A ,B 10-06-1981
			GB 2133526 A ,B 25-07-1984
			JP 56082312 A 06-07-1981
			US 4378207 A 29-03-1983
			US 5046944 A 10-09-1991
			US 4500283 A 19-02-1985
			JP 58016177 A 29-01-1983
			US 4474552 A 02-10-1984
			JP 1759135 C 20-05-1993
			JP 4049004 B 10-08-1992
			JP 60213718 A 26-10-1985
			US 4604054 A 05-08-1986

INTERNATIONAL SEARCH REPORT

information on patent family members

International Application No

PCT/US2004/010111

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 4722681	A	CA 1088412 A1 DE 2714835 A1 GB 1581648 A JP 1249644 C JP 52144831 A JP 59026207 B JP 59137712 A JP 1412505 C JP 60014006 A JP 62019651 B US 4589843 A US 4157155 A	28-10-1980 20-10-1977 17-12-1980 25-01-1985 02-12-1977 25-06-1984 07-08-1984 27-11-1987 24-01-1985 30-04-1987 20-05-1986 05-06-1979
US 3709140	A	09-01-1973	NONE
US 6098614	A	08-08-2000	AU 687930 B2 AU 8170794 A
FR 1447876	A	29-07-1966	NONE
EP 1077348	A	21-02-2001	DE 29516643 U1 AT 250202 T AT 200567 T DE 59606754 D1 DE 59610724 D1 EP 1077348 A1 EP 0769658 A1
EP 0316130	A	17-05-1989	GB 2212257 A EP 0316130 A1 US 4892084 A
DE 2940801	A	23-04-1981	DE 2940801 A1
EP 0514930	A	25-11-1992	DE 4116898 A1 AT 115261 T DE 9117075 U1 DE 59200896 D1 EP 0514930 A2 ES 2065106 T3
CH 329290	A	30-04-1958	NONE
US 5594999	A	21-01-1997	US 5230161 A AU 678777 B2 AU 5221293 A CA 2116906 A1 EP 0618420 A1 JP 7132261 A JP 8022417 B KR 150053 B1 US 5363567 A
FR 1509577	A	12-01-1968	NONE
EP 0162445	A	27-11-1985	DE 3418977 A1 AT 52134 T DE 3577227 D1

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/US2004/010111

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 0162445	A	EP 0162445 A2	27-11-1985
GB 2091869	A	04-08-1982 DE 8113087 U1	18-03-1982
FR 1283540	A	02-02-1962 NONE	
FR 1206247	A	08-02-1960 NONE	